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Application of the Statistical Method to Identify Financial Health of a Company

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Abstract: *At present, there are a number of methods evaluating the financial health of a company. Among them we can find the bankruptcy and creditworthy models created by many authors. Reliability of the models, however, is never 100% reliable and credible when they are applied to the given field of business. The paper is concerned with a selection of the basic sample of financial indicators and the application of the statistical method on selected financial indicators evaluating the financial health of transport companies in the Czech Republic. The paper is aimed to classify the important financial indicators based on the submitted statistical method results.*

Key words: Transport Company · Generalized Linear Model · Financial Health of the Company

JEL classification: M40

1 Introduction

Based on regular financial analyses, the transport company may identify its specific financial situation which, in case of poor results, may result in considerable present and future problems. The goal of the financial analysis is to inform users of the company and the external persons on whether the financial situation of the company is or is not good and to highlight the areas of concern. Based on the results of applied methods of financial analysis, it is necessary to suggest the measures which would fully or partially prevent the bankruptcy of the undertaking. Bankruptcy and creditworthy models consist of the financial indicators the explanatory power of which can identify the financial health of the company. Each model, however, evaluates the company in a different way. The reason is the factors which consider the subject of business, the sector in which the company operates, etc. After application of selected bankruptcy and creditworthy models created by the the Neumaiers spouses on the transport companies in the Czech Republic, their credibility and reliability were verified (Růčková, 2010; Grünwald and Holečková, 2009; Neumaierová and Neumaier, 2002).

Most external users seeking information on the activity of transport companies use the published accounting reports as a source. The frequent mistake is that the users apply the financial analysis methods on the basis of the profit and loss account or the balance sheet and believe that they analyse the main activity only. In most cases, this is not true. In evaluation of the financial health of transport companies, the situation is negative because the transport companies providing traffic services mostly fail to reach a positive economic result. In accounting reports we can find the transport companies which generate profit. The reason is a general inclusion of the main and secondary business activity or a number of secondary business activities.

The goal of the paper is to determine (select) important financial indicators within the application of the statistical method, i. e. a generalized linear model. The results of a statistical method serve as a basis for suggesting a new model which would determine the financial health of the transport company. Before the statistical method application, the financial indicators (variables) which are included in other classification models were chosen. The author chose such a selection of financial indicators which would reflect the current situation in the examined area. The data taken from the Albertina databasis for 2016 served as another source of information. The chosen transport companies are comparable as to their size and organizational structure and both the main business activity and the secondary business activity are considered. As to the determining of the amount of provable loss, the examined entities follow the same methodology. The data includes all balance sheet items, costs and revenues, including the granted subsidies.

2 Methods

2.1 Generalized Linear Model

The generalized linear model is a statistical method which is used in common practice. Unlike the conventional linear model, the assumption of equation between the linear predictor and the model mean value is not necessary. In case of

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the generalized linear model we can assume that the linear predictor is characterized by the transformed mean value. The use of the linear model must meet the basic conditions:

- Random errors are non-systematic,
- Dispersion of residuals is constant (homoscedasticity),
- Random errors are independent,
- Random errors meet the assumption of normal distribution.

By applying the generalized linear model we can predict the systematic component by means of the selected explanatory variables and respect, at the same time, randomness of the background action. Explanatory variables are marked with a symbol X. The random component is generated by a random action which is responsible for the distribution $p(y_i)$ of the variable Y. Independent random variables Y_1 to Y_n can be expected to belong to the so-called exponential-type family with a dispersion parameter φ. Based on this characteristics, we can use the following relation:

$$f(yi\ ;\ \theta i\ ,\varphi) = \exp\ \{[yi\theta i - b(\theta i)]\ /a(\varphi) + c(yi\ ,\varphi)\} \quad (1)$$

where:

θ_i …… natural parameter.

$$y_i = E[Y]_i + \mathcal{E}_i = \mu_i + \mathcal{E}_i \quad (2)$$

where:

y_i …… result of measurement,
$E[Y]_i$ …… combination of a systematic component,
$\mathcal{E}_i$ …… random component,
Y …… observation of a random variable,
μ_i …… systematic component.

By means of uniquely invertible and differentiable function (g), the systematic component (μ_i) is the so-called linear predictor which expresses the linear function of the model parameter. The following relation exemplifies this:

$$g\ (\mu_i) = \eta_i \text{ » } \mu_i = g^{-1}\ (\eta_i). \quad (3)$$

Mathematically, it is apparent that the systematic component μ_i of the generalized linear model is a function of the linear predictor η_i. It can be assumed that the linear prediction function represents the transformed mean value. Within the generalized linear model, β marks the coefficients expressing the effect of individual explanatory variables on the modelled variable the values of which are searched for. The explanatory values (variables) may have both the quantitative and qualitative values. Quantitative values are also referred to as continuous and qualitative values are referred to as a categorical unit (Anděl, 2003; Pekár, 2009; Šimurda, 2007; Wonnacott, 1993).

2.2 Input Data

As the input data the author selected the basic samples of transport companies headquartered in the Czech Republic, which provide the traffic services, including the secondary traffic services. Based on the financial and accounting data for 2016 obtained from the Albertina server, the analysis for the selected transport companies was made. The results of the creditworthy model IN 99, which appeared the most credible within the analysis of the financial health of transport companies in the Czech Republic as compared to other bankruptcy and creditworthy models by the Neumaiers spouses, were selected as the explained variable.

The following financial indicators were chosen:

- Return on equity (profit/loss before taxation and interest/equity),
- Return on assets (profit/loss before taxation and interest/fixed assets),
- Activity indicator (revenues/fixed assets),
- Indebtedness indicator (fixed assets/external resources),
- Interest coverage (profit/loss before taxation and interest/interest payable),
- Interest coverage on condition of the cash flow (cash flow/interest payable),
- Return on revenues (profit/loss before taxation and interest/(revenues from the sale of own products and services + revenues from the sale of the goods),
- Monetary liquidity (short-term financial assets/(short-term liabilities + short-term bank loans),
- Fixed assets turnover (revenues/fixed assets),

- Indebtedness indicator (external resources/equity).

Table 1 Input data

Carrier	Y	ROE	ROA	Revenues / assets	Assets / ER	EBIT / IP	CFLOW /IP	EBIT / Revenues	Monetary liquidity	Revenues / FA	ER / EQ
A	0.69	0.053	0.032	1.137	2.567	9.628	57.882	0.058	0.021	0.611	0.639
B	1.67	0.229	0.191	1.570	6.036	280.498	439.284	0.199	0.677	1.412	0.199
C	0.04	0.154	0.007	0.018	1.050	0.000	0.000	0.000	0.011	0.000	19.955
D	0.5	0.061	0.036	0.622	2.481	34.979	83.362	0.124	0.013	0.434	0.676
E	0.9	0.360	0.025	1.658	1.074	1.649	9.538	0.034	0.018	1.037	13.544
F	0.51	0.187	0.028	0.809	1.178	3.005	15.543	0.077	0.010	0.393	5.605
G	1.26	0.146	0.079	1.820	2.181	15.429	31.089	0.045	0.491	2.652	0.847
H	0.89	0.148	0.076	1.147	2.091	14.395	37.451	0.121	0.029	0.681	0.930
CH	0.59	0.045	0.033	0.886	4.511	436.095	1729.048	0.064	0.831	0.670	0.296
I	0.5	0.030	0.022	0.780	4.064	20.505	98.893	0.056	1.364	0.486	0.333
J	0.22	0.004	0.003	0.422	4.465	1.127	24.734	0.015	0.355	0.204	0.293
K	0.07	-0.003	-0.002	0.115	3.110	0.000	0.000	-0.020	0.636	0.198	0.475
L	0.27	0.001	0.001	0.497	6.305	0.892	105.164	0.004	1.412	0.234	0.191
M	0.22	-0.037	-0.033	0.718	10.114	-189.917	254.792	-0.063	0.459	0.583	0.112
N	0.2	0.001	0.001	0.337	12.226	0.000	0.000	0.003	2.205	0.182	0.091
O	0.3	0.017	0.011	0.465	3.161	0.000	0.000	0.050	1.145	0.538	0.468
P	0.24	-0.022	-0.018	0.625	5.781	0.000	0.000	-0.072	1.216	0.319	0.213
Q	0.44	0.013	0.012	0.692	13.999	0.000	0.000	0.035	3.060	0.450	0.078
R	0.09	-0.050	-0.033	0.493	3.033	-13.560	19.869	-0.135	0.070	0.260	0.495
S	0.21	0.001	0.001	0.349	7.784	4608.000	269578.000	0.008	2.060	0.127	0.148
T	0.34	0.000	0.000	0.547	15.101	0.000	0.000	-0.001	3.886	0.379	0.072

Source: Author´s own processing

Due to the sensitivity of economic data processing, the transport companies are marked with the letters. The author knows all economic and financial structures of individual transport companies.

The analysis will be made using the statistical model (generalized linear model) in the STATISTICA programme.

3 Research results

Upon the results of the correlation matrix, it is apparent that the fields marked in red represent the significance among individual variables with the condition that the significance is determined on the level p = 0.05. The table below shows the results of the correlation matrix (analysis).

Table 2 Results of the correlation analysis application

	IN 99 (Y)	ROE	ROA	REVENUES / ASSETS	ASSETS / ER	EBIT/IP	CFLOW / IP	EBIT/ REVENUES	MONETARY LIQUIDITY	REVENUES / FA	ER / EQ
IN 99 (Y)	1.000000	0.683195	0.914214	0.912854	-0.206501	-0.097140	-0.151007	0.734301	-0.210716	0.822744	-0.056353
ROE	0.683195	1.000000	0.620458	0.665021	-0.475838	-0.109309	-0.138809	0.574267	-0.418788	0.489359	0.616556

ROA	0.914214	0.620458	1.000000	0.673671	-0.215258	-0.035120	-0.101592	0.850803	-0.198437	0.630300	-0.034216
REVENUES / ASSETS	0.912854	0.665021	0.673671	1.000000	-0.240479	-0.156453	-0.188905	0.496440	-0.267750	0.863556	-0.022067
ASSETS / ER	-0.206501	-0.475838	-0.215258	-0.240479	1.000000	0.116677	0.132135	-0.206322	0.880109	-0.205204	-0.412878
EBIT / IP	-0.097140	-0.109309	-0.035120	-0.156453	0.116677	1.000000	0.993460	-0.003305	0.231161	-0.147136	-0.101749
CFLOW / IP	-0.151007	-0.138809	-0.101592	-0.188905	0.132135	0.993460	1.000000	-0.063074	0.234682	-0.173461	-0.092195
EBIT/REVENUES	0.734301	0.574267	0.850803	0.496440	-0.206322	-0.003305	-0.063074	1.000000	-0.140520	0.382755	-0.019270
MONETARY LIQUIDITY	-0.210716	-0.418788	-0.198437	-0.267750	0.880109	0.231161	0.234682	-0.140520	1.000000	-0.192970	-0.354821
REVENUES / FA	0.822744	0.489359	0.630300	0.863556	-0.205204	-0.147136	-0.173461	0.382755	-0.192970	1.000000	-0.076992
ER / EQ	-0.056353	0.616556	-0.034216	-0.022067	-0.412878	-0.101749	-0.092195	-0.019270	-0.354821	-0.076992	1.000000

Source: Author´s own processing

Table 2 shows that the variables ROE; ROA; REVENUES / ASSETS; EBIT / REVENUES; REVENUES / FA have a significant effect on the observed variable IN 99. If we apply the generalized linear model, however, we will obtain the following results (Table 3).

Table 3 Results of the generalized linear model application 1

Effect	Degrees of freedom	Wald. Stat.	p
Abs. member	1	1159.73	0
ROE	1	4.891	0.026991
ROA	1	44.001	0
REVENUES / ASSETS	1	379.158	0
ASSETS / ER	1	2.348	0.125423
EBIT/IP	1	8.326	0.003908
CFLOW / IP	1	9.643	0.001901
EBIT / REVENUES	1	135.767	0
MONETARY LIQUIDITY	1	16.524	0.000048
REVENUES / FA	1	9.222	0.002391
ER / EQ	1	15.848	0.000069

Source: Author´s own processing

Based on Table 3, we can observe that the variable "assets / external resources" is not significant and, therefore, it will be excluded from the model. Other explanatory variables marked in red represent the significance and dependence on the explained variable. It means that the significance level did not exceed p value of 0.05. The random variable component meets the assumptions of normal distribution, homoscedasticity and data independence. After excluding the insignificant variable (assets / external resources), the values of other variables will change in the next step.

Table 4 Results of the generalized linear model application 2

Effect	Degrees of freedom	Wald. Stat.	p
Abs. member	1	1192.898	0
ROE	1	5.43	0.019789
ROA	1	58.663	0

REVENUES / ASSETS	1	337.143	0
EBIT / IP	1	8.802	0.003009
CFLOW / IP	1	9.685	0.001858
EBIT / REVENUES	1	141.316	0
MONETARY LIQUIDITY	1	33.359	0
REVENUES / FA	1	6.131	0.01328
ER / EQ	1	15.339	0.00009

Source: Author´s own processing

After excluding the variable assets / external resources, the values of other variables will change after the application of the next step of the generalized linear model. If we compare the final values of the correlation matrix and the results of the generalized linear model, we can observe that the variables EBIT / IP; CFLOW / IP; MONETARY LIQUIDITY; ER / EQ are insignificant as per the correlation analysis and do not need to be included in the model. The fact, however, is that the above variables appear to be significant in Table 4. In this paper, it would be sufficient to apply the correlation analysis which explains the dependency of individual variables among each other. The application of the generalized linear model has proved that the significant variables within the correlation analysis are also significant in the results of the generalized linear model.

The normal distribution assumption is met.

4 Conclusions

The application of the correlation analysis and the generalized linear model results in the differences as to the significance of selected variables (financial indicators). It applies, however, that the results of the correlation analysis and its determination of significance of financial indicators appear to be identical with the generalized linear model. It means that the variables: ROE; ROA; REVENUES/ ASSETS; EBIT / REVENUES and REVENUES / FA are also significant in the generalized linear model.

Using the generalized linear model and other statistical methods, we can additionally examine the other chosen explained variable which is a part of the input data in this paper. The results (Table) of the correlation analysis are, however, the clearest.

Within the evaluation of the transport company´s financial health, it is not too important whether the company reports the amount of interest payable from the granted loans or credits but whether it can generate profit without the help in the compensation of a provable loss. The interest payable occurs very rarely, unless the transport companies invest their own money in the renewal of their rolling stock. In a simplified way, the provable loss represents a subsidy provided by the customer ordering the transportation. It is a part of revenues and revenues also serve for the calculation of the profit/loss. Even granting of the subsidy by the customer ordering transportation or other parties often fails to cover the losses from the main business activity. The transport company fails to generate the reasonable profit due to the innovation of business processes (renewal of the rolling stock, other investments). The sudden events (car crashes, fire, flood) causing the damage to the property result in other additional costs which are partly covered by the financial compensation of the customer on the basis of the reference data provided by the Police of the Czech Republic and the relevant insurance company. The compensation of the provable loss from the main business activity refers to the public service contract made by and between the customer and the carrier. This, however, does not mean that the customer is obliged to fully pay all unprofitable activities of the carrier which have occurred. This would lead to the situation when the transport companies would creatively adjust the accounting data which significantly affect determining of the provable loss amount. The transport companies, hence, attempt to cover the loss from their main activity using the profit generated from the secondary business activity. The customer is not interested in whether the transport company has any secondary business activity. The goal is to find other sources of money from the provided traffic services.

The fact is that the financial indicator with the economic result element should not be missing in the proposed model evaluating the financial health of the transport company. The results of the correlation analysis and the generalized linear model offer utilizing of the return on assets, return on equity, etc.

Another indicator is the cash flow. Its explanatory power is more credible than the calculation of the profit/loss itself. The more exact results are provided by the cash flow determined by a direct method. This method is, however, too demanding and hardly usable in the transport practice. Instead of the direct method of cash flow calculation, the indirect method is applied. It is based on the calculated profit/loss which is adjusted with the non-monetary operations, etc.

It depends on the user which financial indicators will be selected. Their application on the sample of selected companies is, however, important as much as the fact whether they reflect the real activity of the companies or not.

List of Abbreviations:

EBIT …… earnings before interest and taxes

FA …… fixed assets

CFLOW …… cash flow

ROE …… return on equity

ROA …… return on assets

ER …… external resources

IP …… interest payable

EQ …… equity

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